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ABSTRACT

Emphasis on national goals such as those related to urban development, housing, and transportation will create a need for new construction and a demand for workers in the structural, mechanical, and finishing occupations. This projected increase in demand for construction workers has resulted in a need to synthesize information related to the training of those skilled workers with special emphasis directed toward curricula for emerging occupations. To assist practitioners in identifying current curriculum offerings, useful materials for improving operating programs, and voids in the present research framework, a review and analysis were made of the literature related to construction occupations. In his analysis of the literature the author examines (1) The Need for Educational Programs, (2) Curriculum Materials, (3) Curriculum Development, and (4) Methodology for Curriculum Development. Attention is directed to the educational planning system for curriculum development and the need for a complete communications system for those affected by the educational program. (JS)

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REVIEW AND ANALYSIS OF CURRICULA FOR OCCUPATIONS IN CONSTRUCTION

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PREFACE

This *Review and Analysis of Curricula for Occupations in Construction* is one of a series of information analysis papers in vocational and technical education and related fields. It should aid curriculum development specialists, researchers, and practitioners in assessing the current "state of the art" in the field. The compact nature of the review should be of assistance to practitioners in identifying current curriculum offerings and useful materials to improve operating programs. They should also assist in identifying voids in our present research framework and enhance future studies, both in terms of their substantive focus and methodological approaches.

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The profession is indebted to Wiley B. Lewis for his scholarship in the preparation of this report. Recognition is also due Arthur Jensen, director, Vocational Educational Media Center, Clemson University, and Albert J. Pautler, Department of Vocational and Technical Education, Rutgers—The State University, for their critical review of the manuscript prior to its final revision and publication. J. David McCracken, information specialist at The Center, coordinated the publication's development.

Members of the profession are invited to offer suggestions for improvement of information analysis papers and suggest specific topics or problems for future reviews.

Robert E. Taylor
Director
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INTRODUCTION

Job openings in the construction industries are expected to show a rapid numerical increase during the 1970's because of an increasing concern toward attaining national goals. Rebuilding urban areas, improving utilities and public services, replacing substandard housing, and developing new urban transportation networks will create a need for new construction. Moreover, construction projects to replace, modernize, and expand industrial, commercial, military, and other governmental plants, buildings, and facilities will continue to expand rapidly in the foreseeable future despite occasional slowdowns due to economic, political, and sociological considerations.

Construction job openings will center around three primary occupational categories—structural, mechanical, and finishing occupations. The general types of work performed by individuals in each of these categories can be determined by referring to the general worker classifications shown in Figure 1 (Teeple and Kenadjian, 1969). It is recognized that this listing is not all inclusive and will serve only as an orientation point for consideration in this discussion of the industries. Further information concerning the listed occupations and related occupations may be obtained by referring to the *Dictionary of Occupational Titles, 1965* and its supplements.

FIGURE 1
MAJOR OCCUPATIONAL CATEGORIES COMPOSING THE CONSTRUCTION INDUSTRIES*

STRUCTURAL OCCUPATIONS	MECHANICAL OCCUPATIONS	FINISHING OCCUPATIONS
Boilermakers	Electricians	Asbestos workers
Bricklayers, stonemasons, and tilesetters	Elevator constructors	Floor coverers
Cabinetmakers	Plumbers and pipefitters	Glaziers
Carpenters	Tinsmiths, coppersmiths, and sheet metal workers	Lathers
Cement masons		Marble setters
Cranemen, derrickmen, and hoistmen		Painters
Excavating, grading, and road machinery operators		Paperhangers
Structural metal workers		Plasterers
		Roofers

* Prepared from information presented in the following publication: John Teeple and Berdj Kenadjian, *The Pursuit of National Goals and Career Opportunities in the Construction Crafts in the 1970's*. Working Paper. Contract OEG-0-8-080643(085), U.S. Office of Education, Department of Health, Education and Welfare. (Washington, D.C.: Center for Priority Analysis, National Planning Association, 1969), p. 27.

While the information shown in Figure 1 uses terminology familiar today instead of possible future terms, it is believed that the worker classifications will remain essentially stable while the tasks performed and the materials and procedures used will undergo much revision. Lack of an adequate supply of trained manpower in these occupational categories can frustrate the attainment of high-priority national objectives in many fields.

A rapidly growing demand for construction manpower, coupled with the current situation of a slowly increasing supply has two principal implications for planning in vocational education (Teeple and Kenadjian, 1969). First, rapid expansion in construction means parallel expansion in a broad spectrum of needs for skilled labor. Secondly, it implies an expanding base of job opportunities for individuals in the "left out" groups in American society.

Statement of the Problem

Projected demands for increased numbers of construction workers have resulted in a need to synthesize information related to the training of skilled workers for the construction industries with special emphasis directed toward curricula for emerging occupations. As new technological and scientific findings are developed, many existing occupational curricula will require revision or completely new approaches. Thus, providing instruction in the emerging occupational areas will be a challenge to those persons responsible for the programs. This analysis of literature related to the construction industries was undertaken in an effort to help these individuals:

1. Assess the availability and current development of curricula, materials, and guides for their development and use;
2. Identify promising developments and findings in the construction occupational areas; and
3. Identify and describe the major conclusions and future research and development alternatives.

To help in meeting these needs, the remainder of this report will be directed toward accomplishing the following objectives:

1. To determine if additional educational programs are needed, and if so, identify which occupational areas require instructional emphasis;
2. To determine if curricula and curriculum materials are presently available for use in preparing students for occupational areas identified as important;
3. To identify the techniques and procedures used for developing available curricula and for providing instruction; and
4. To identify the techniques and procedures which should be used for developing curricula and for providing instruction in the future.

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REVIEW AND ANALYSIS OF CURRICULA FOR OCCUPATIONS IN CONSTRUCTION

REVIEW AND ANALYSIS OF THE LITERATURE

Publications and documents listed in the bibliography were reviewed and analyzed in an effort to identify the major findings, promising developments, strategies, and methodological strengths and weaknesses which exist in the curricula designed for training workers in the construction industries. It was believed that such a review and analysis would reveal much which might be of interest to those persons responsible for educational programs in this area.

Need for Educational Programs

Estimates for the 1970's indicate annual openings for an anticipated 291,000 skilled workers in the construction industries (Teeple and Kenadjian, 1969). However, the primary sources of formal training for the occupations involved, including the vocational education system, turned out only 68,000 students who had completed training programs in these occupations in 1967. This imbalance underscores the need for reassessing priorities in planning programs in vocational-technical education.

Current training programs come closer to meeting needs in some occupational areas—electricians and tinsmiths, coppersmiths, and sheet metal workers, for example—than in others such as cranemen or operators of excavating and grading machinery (Teeple and Kenadjian, 1969). The low ratio of training completions to anticipated job openings for cranemen and road machinery operators creates a presumption that sizeable returns would be likely to result from a considerably greater concentration on programs in these fields.

This presumption was reinforced by Lecht (1968) who indicated that excavating, grading, and road machinery operators, based on expected percentage of increase in employment, were in high growth occupations. In addition, he indicated that electricians, painters, plumbers, masons, cranemen, derrickmen, and hoistmen were in moderate growth occupations while cabinetmakers, carpenters, tinsmiths, coppersmiths, and sheet metal workers were in low growth occupations. Similar trends were reported in a study, *Occupational Employment Patterns for 1960 and 1975*, which was sponsored by the Manpower Administration.

On the basis of available information it is possible to rank the major occupational categories and their component occupations according to the percentages of increase in the number of workers expected between 1966 and 1975. Such a ranking would show that structural occupations were expected to show the greatest increase, followed by the mechanical occupations and the finishing occupations. The general ranking of each of the occupations within these areas as developed from information provided by Teeple and Kenadjian (1969) is shown in Figure 2. It must be remembered that these rankings, based on projected increases, were, and still are, subject to change because of changing con-

ditions in the occupational areas. However, such rankings should prove of value to those individuals responsible for planning vocational education programs.

FIGURE 2

RANKINGS OF OCCUPATIONS COMPOSING THE CONSTRUCTION INDUSTRIES ACCORDING TO EXPECTED PERCENTAGES OF INCREASE IN EMPLOYMENT, 1966-1975*

STRUCTURAL OCCUPATIONS	MECHANICAL OCCUPATIONS	FINISHING OCCUPATIONS
Structural metal workers	Elevator constructors	Glazers
Excavating, grading, & road machinery operators	Plumbers and pipe-fitters	Lathers
Cabinetmakers	Electricians	Paperhangers
Bricklayers, stone-masons, & tile-setters	Tinsmiths, coppersmiths, and sheet metal workers	Floor coverers
Cement masons		Roofers
Cranemen, derrickmen, & hoistmen		Marble setters
Carpenters		Painters
Boilermakers		Asbestos workers

* Prepared from information presented in the following publication: John Teeple and Berdj Kenadjian, *The Pursuit of National Goals and Career Opportunities in the Construction Crafts in the 1970's*. Working Paper. Contract OEG-0-8-080643(085), U.S. Office of Education, Department of Health, Education and Welfare. (Washington, D.C.: Center for Priority Analysis, National Planning Association, 1969), p. 27.

Since the occupations for which preparation will be needed have been identified in a general manner, consideration should be given to the individuals who should receive such preparation. Vocational education in the areas related to construction is primarily significant as adult education for persons already in the labor force. Most of this training was provided by the secondary school systems (Teeple and Kenadjian, 1969).

In addition to this type of preparation, vocational education programs also provided pre-employment training for high school students. According to McCauley (1967), such training can ensure a certain standard of competence upon entry into an occupation and young people can learn about a trade before committing themselves to apprenticeship. Pre-employment training also provides an opportunity for giving training in basic subjects such as mathematics or English and can aid members of minority groups in entering apprenticeship. This latter condition is very important but as indicated in a Manpower Administration publication, *Negroes in Apprenticeship*, (1967) major efforts must also be directed toward recruiting and counseling applicants from these groups.

While there is a need for expanding programs in the construction trades for providing this training to high school students, the national policy of in-

creasing and upgrading employment opportunities for the disadvantaged implies a continued emphasis on adult programs in the construction fields (Teeple and Kenadjian, 1969). Though many job-oriented educational programs for the disadvantaged have been developed through the alliance of private industry and the schools (Banta and Others, 1969), additional and more refined programs will be needed for future training.

In the construction industries, vocational education exists side-by-side with other training systems designed for preparing individuals for employment. These other systems include the apprenticeship system, programs conducted under the auspices of the Manpower Development and Training Act (MDTA), the Job Corps, post-high school institutions, and other proprietary schools. But even with all of these systems, the number of trained workers is inadequate. Because of this, vocational education will remain viable in this area. Enrollment in high school vocational courses can provide pre-apprenticeship training and can encourage students to remain in school and acquire educational credentials suitable for entrance into an apprenticeship program or other specialized training. Vocational education along with MDTA and Job Corps programs have also provided basic education and occupational training courses to serve the needs of unemployed workers or workers whose job skills had been made obsolete by economic and technological changes. Vocational education personnel have also cooperated with industry and union personnel in conducting apprenticeship programs. In the future, the emphasis in vocational education may be shifted from programs conducted in the secondary schools to the training of individuals as technicians and semiprofessionals on the post-high school level.

While increased educational opportunities are imperative, it should be realized that a period of time will be required before all workers entering the industries receive some type of formal training. A recent survey showed that a majority of the craftsmen learn their trades in an informal manner which is generally on-the-job training (Doyle, 1967). Teeple and Kenadjian (1969) indicated there was a need to double at least the enrollments in high school and special adult courses related to the construction industries in the next five years.

Curricula and Curriculum Materials

Educators have indicated that the curriculum is the "backbone" of the instructional process. It serves as a road-map for vocational instructors to chart the course from meager student interest and knowledge of a vocation or cluster of vocations to achievement of the goal of employment in that vocation. The success of the instructional program is wrapped-up, to a great extent, in the effectiveness of the curriculum.

Since the curriculum is important, a common understanding of its meaning should be established. The term has been defined many ways but according to Leighbody it "is the sum total of the learning experiences for which the school has responsibility, whether they occur in school or not" (*Papers Presented at the National Conference on Curriculum Development in Vocational and Technical Education*, 1969). It should provide an outline of the practical training and

related instruction required for the acquisition of a specific level of skill and knowledge in a particular occupation or cluster of occupations.

With this definition as a basis, appropriate literature was reviewed to determine the availability of curricula for the construction industries. It should be noted that many of the documents reviewed as curricula by the writer were really multipurpose items which also would fit in the categories of curriculum guides and courses of study.

For the construction industries, a great number of curricula were found and reviewed. These curricula were designed to be used for preparing students for a single occupation or a cluster of occupations. For example, *A Basic Plan for the Organization and Management of Instruction in Vocational Carpentry* (1967) was designed soley for the preparation of carpenters while the curriculum in *The Preparation of Curriculum Materials and The Development of Teachers for an Experimental Application of the Cluster Concept of Vocational Education at the Secondary School Level* (Maley, 1967) was prepared to provide for basic student needs in the areas of carpentry, electricity, masonry, painting, and plumbing.

A review of available curricula revealed that while many curricula were available, these are generally related to the occupations in which the greatest number of people are employed or in which the greatest employment growth has occurred. The literature searches conducted in relation to this analysis indicated that such material was lacking or not available for several specific occupations. For the occupational areas of masons, carpenters, electricians, plumbers and pipefitters, smiths, and painters, curricula were generally available. On the other hand, curricula related to paperhangers, boilermakers, structural metal workers, and excavating, grading, and road machinery operators, the latter being a rather high employment occupation, were almost nonexistent. Only one curriculum was discovered during the searches for preparing individuals to operate, maintain, and repair heavy equipment (Malanich, 1969).

Curricula reviewed generally were designed for one of three groups of individuals—apprentices; adults, pre-employment and post-secondary; and high school students. Though instruction for the three groups is interrelated, the curriculum should be prepared for the type of student being served. Liewer and his associates' (1968) *Light Metals 5-6, Occupational Industrial Course Outline* is prepared for high school students while the *Guide for Course of Study for Millman* (McDonough, 1966) was designed for adults in MDTA programs. The publication *Suggested Guidelines for Developing a High School Trade and Industrial Program in Sheet Metal* (1968), on the other hand, contains a suggested curriculum for an apprenticeship program.

In addition to curricula, other curriculum materials were identified during the searches. Selected items belonging to this category may also be found in the bibliography. These materials were selected on the basis of Olivo's (Larson and Blake, 1969) definition of curriculum materials which states that "curriculum materials in vocational education refer to all the audio-visual sensory teaching-learning materials and devices used by the teacher and/or learner to teach or to

master effectively and efficiently the skills, technologies, and general areas of learning required as a worker and as a citizen."

While it was found that textbooks, workbooks, study guides, standards, and instructor's guides were abundant in the construction industries, only one example of programmed units was found in the review—Carl's (1963 and 1964) publications concerning *Thermal Insulation*. As was true with the curricula, most of the material is for the high-employment occupations such as carpentry, electricians, and masons. Such materials were not generally available for low employment occupations and heavy equipment operators.

One should not consider that such materials—curricula or curriculum materials—do not exist if they are not included in the bibliography. Many of these materials were prepared locally and/or on a limited budget and were not available for distribution. Too, this same effect appears to have contributed to the duplication of effort which can be found in several of the occupational areas, especially carpentry and electricity. Lack of distribution has probably caused other persons to prepare similar materials so they will be available for immediate use. Though extra effort has been required, one should consider that it is generally recommended that those persons associated with the program should participate in developing the curriculum. If vocational teachers are to contribute as they should to curriculum improvement, they must participate, on a continuing basis, in curriculum development. But such development is not the teacher's task alone. A team composed of teachers of related basic subjects, researchers, and specialists from the field of work should be involved (*A Guide for the Development of Curriculum in Vocational and Technical Education*, 1969).

The lack of bibliographic entries related to types of curriculum materials other than printed matter was not intentional. Failure of persons in the construction industries to make greater use of television, projectors, tape recorders, teaching machines, and other media indicates that the "media have been treated as addenda, as interesting appendages, instead of as the bricks from which actual curricula experiences are built" (Finn and Others, 1967).

Caution should be exercised in selecting and using the materials listed in the bibliography. Each of the items was prepared for use with specific groups of people. Apprenticeship curricula generally are not appropriate for training high school students nor are curricula developed for the latter generally appropriate for training apprentices.

An additional consideration is important in the use of available materials. Many of the items reviewed were prepared several years ago. This was found to be true especially for the areas of carpentry, masonry, boilermaking, and plumbing. Because of technological developments which have occurred within these and the other construction occupations, many of these older publications may contain inaccurate information. Thus, caution should be exercised in their selection and use.

Because of the above mentioned consideration, items listed in this section of the bibliography were restricted to those with publication dates of 1960 or later. In this manner, it was hoped that the material would be up-to-date and of more value to educators or other interested persons.

It should be noted that a wide variety of sources were responsible for the preparation of the curricula and curriculum materials listed. Though educational institutions were responsible for much of the material, private businesses, labor organizations, and governmental agencies made a great contribution. Because of the many sources from which such materials may be obtained, care should be exercised to secure instructional material from a reliable and competent source.

Curriculum Development

Analyses for Curriculum Development

Present practices and procedures related to curriculum development must be considered as a basis for developing curricula for new and emerging occupations. Larson (1969) has indicated that "curriculum development based on employment needs is the essence of effective payroll education for the youth and adult in today's world." Since this belief was generally accepted by vocational educators, job analysis has been used for many years as the basis for curriculum development for occupations in the construction industries. Because of continued and increasing employment needs, job analysis—the process of studying the operations, duties, and organizational relationships of jobs to obtain data for reporting the significant worker's activities and requirements—will continue to be an important part of such development. However, such analysis will be conducted under stricter guidelines and controls. The importance of such a process was supported by Olson (1969) in his statement that curricula based on functional job analysis is imperative for the success of the educational program.

Larson's (1969) review of curricula literature also revealed that task analysis is being used to a greater extent. This type of analysis is a method or process by which a task, a subunit of a job, is examined and its characteristics, in terms of certain attributes, are identified. The curriculum is then prepared on the basis of this analysis.

An example of this type of analysis may be found in Maley's work at Maryland. This work could well serve as a foundation for future curriculum development in the construction industries, especially at the secondary school level. His reports (Maley, 1966 and 1967) include behavioral objectives; a core curriculum; and suggested teaching methods, instructional materials, student activities, and evaluation procedures which may be of value for the future development of curricula in such occupational clusters. Furthermore, Mager and Beach (1967) suggest that this type of analysis be used as a basis from which to develop a course.

A third type of analysis which has sometimes been used for developing curricula is occupational analysis. This type of analysis involves techniques similar to those of job or task analysis but the scope of the research is much greater. Occupational analysis has been described by Borow as the application of a systematic method of obtaining information focused on occupations and industries as well as on jobs, tasks, and positions (Larson, 1969).

Tuckman (1968) has introduced a fourth type of analysis—structural analysis. This type of analysis is a systematic approach to curriculum development

representing an attempt to organize terminal performance objectives for a unit of subject matter into a sequence of prerequisite competencies which must be satisfactorily mastered if successful performance is to occur. By using this technique a hierarchy of requisite competencies is generated which parallels the learning process appropriate to the final task.

Information used in these analyses has been obtained by observing, interviewing, or submitting questionnaires to appropriate personnel related to the occupation and by analyzing the content of textbooks and related curricula. Of the curricula and curriculum materials reviewed during the preparation of the report, most were prepared on the basis of information contributed through the combined efforts of workers in the occupational area and vocational educators.

Systems Approach

Both Miller (1969) and Larson (1969) have indicated that the systems approach to curriculum development is increasing in importance. This approach involves job and task analyses and further extends the development process by requiring performance objectives along with an educational strategy to meet these objectives and selection criteria for the students. According to Miller (1969), this final step is important for unless the student has the proper educational background and personality characteristics, the dropout rate will be high. Johnson (1967) reported that such a rate exists in the apprenticeship training programs and suggested that a battery of aptitude and interest tests be administered and the results used as a basis for program entry.

The consideration of selection criteria appears to be of extreme importance in the construction industries. While material was reviewed concerning general occupational information such the the *Job Guide for Young Workers* (U.S. Department of Labor, n.d.) and *Start Your Career With Apprenticeship in Washington, D.C.,* (1966), no specific selective criteria were located. Because of this apparent lack of materials, efforts should be made to develop and distribute items suitable for student, counselor, and teacher use. Criteria should be prepared for high school, apprentice, adult, disadvantaged, and women students in an effort to promote entry of individuals into the construction industries. Maker and Beach (1967) recognized the value of selection criteria in their publication, *Developing Vocational Instruction.*

Broad Training Base

Many of the curricula, including pre-employment curricula, were prepared for narrow occupational categories. However, Maley (1966) has indicated that the cluster concept is best for persons enrolled in pre-employment training programs. Under this concept, high school students and adults would receive a broad base of training which would help make them mobile and flexible in a job situation and provide increased employment opportunities and an opportunity to grow (Maley, 1966). Present conditions indicate that pre-employment curricula will be planned on this basis and that more flexibility will be incorporated into the other programs.

Grummitt (1969) has also indicated a need for a broader training base. He advocated that jobs in the construction trades be referred to in groups such as the trowel trades (bricklaying, concrete masonry, tilesetting, etc.) and that training be given on the basis of the groups. He considered realism and action as the primary requirements in the training situation for these groups along with a need for testing and certification of the students. This writer concluded from the review of literature that little had been accomplished in the vocational programs concerning such testing and certification for programs related to the construction industries.

A further but more restrictive view of realism was referred to by Collins (1969). In the Thamesmead Project, apprentices were trained to suit the specific strata on which they were working. This type of training was developed to prevent the "hermit syndrome" which was described as the situation which occurs when the student is prevented from putting into practice his new concepts and teachings. Such a training program was developed because the skill or knowledge secured through conventional programs might become outdated before application and to prevent the trainee from feeling let down or frustrated and maintain training as a dynamic situation. With our present emphasis on advancement within a job area, it is doubtful if this will develop as a primary type of vocational program. However, some of its characteristics are appearing in the form of programs with multi-exit points.

Simulation

While realism is important, the high cost of equipment and facilities and the space required for realistic training in some occupations place it on the post-high school level or in private schools. This is especially true for occupations involving excavating, grading, and road machinery operators and structural metal workers. One possible method which could be used to alleviate this situation is simulation. Simulation is the creation of a situation which could occur in real life, usually with the variables simplified, for the purpose of instruction (Tansey and Unwin, 1968). Such simulation would help to bridge the gap between practical knowledge and purely theoretical knowledge and make training available to a greater number of people, including those in minority groups. This technique could be used to greater advantage in many occupational training programs.

Curriculum Materials

While some of the more recent projects have treated curriculum materials as an important part of curriculum development, more work must be done in this area. This is very important for while most educators know how to use media such as projectors, tape recorders, and television systems, few know when they should be used (Finn and Others, 1967). Publications such as *Skill Training for the Job* (Cenci, 1966) and *How to Train Workers on the Job* (1966) might prove of value in preparing instructors to use this material effectively. Instruction should be planned as a system to incorporate all of the media considered appropriate into a process which will result in the most efficient and effective learning.

Methodology of Curriculum Development

How then, should curricula be developed to prepare workers for their new and emerging roles and to update their skills and knowledge once they have entered the occupation? It is possible and very probable that research being conducted at the present time will help to answer this question. However, the literature reviewed during the preparation of this analysis contained little material related to current projects of notable interest concerning curriculum development in the construction industries. This does not mean that projects are not being conducted but that such projects were of local interest or simply not reported in the literature reviewed. One project worthy of note is a pilot project in which instruction guides similar to *Concrete in the Field-I* (1969) are being tested. The guides are part of a national program to train personnel for employment as technicians in the cement and concrete industries.

Analyses for Curriculum Development

Even without such research, it is possible to formulate procedures for the development of curricula which will keep pace with changes in present occupations. As a basis for such development, one must consider that "a realistic, functional curriculum depends upon an understanding of the needs and requirements of the occupational field. Determination of the elements of the occupation (the skills, knowledge, habits, and attitudes essential to employment) demand an occupational analysis" (Larson and Blake, 1969). Thus, the use of job and task analyses will still serve as the primary means of providing the data necessary for curriculum development. The use of these analyses is possible because as Roney has indicated, "occupational education is based upon the premise that the factors contributing to success in an occupation are relatively well-known and can be converted into certain educational experiences" (Larson and Blake, 1969).

But such analyses will be expanded to create a zoned analysis of the occupation. According to Larson, zoned analysis is a method of graphic delineation which may be explained as a system through which factors involved in any organization or research project may be arranged in orderly sequence on an easy-to-understand chart (Larson and Blake, 1969). Such an anaylsis proceeds from the general to the specific according to a predetermined and definite plan. The zoned analysis technique will aid the developer in preparing curricula for various employment levels within an occupation or in preparing a curriculum with multi-exit points.

But how can one analyze a job which is just emerging? Such a situation requires the complete cooperation of personnel in education and industry for the analysis should begin as the change is introduced. Priore (1968) indicated that when the normal training patterns are disrupted by new processes, industry continues to fall back on on-the-job training. The innovation is demonstrated to the operator who then perfects the requisite skills while performing the job. For the educator to analyze the job during this period, a communications network must be established and maintained with industry personnel and the

workers. Because the introduction of change is a variable process, a system must be developed to constantly monitor the occupation involved in an effort to detect change.

If curricula were prepared on a national basis as proposed by Olson (1969) or even a state basis as suggested by Crabtree (1967), and then revised for relevance to students in a given school, such a monitoring system would be feasible. In addition, curricula prepared on these levels would increase the need for standards of instruction and student performance which could lead to improved programs.

Systems Approach

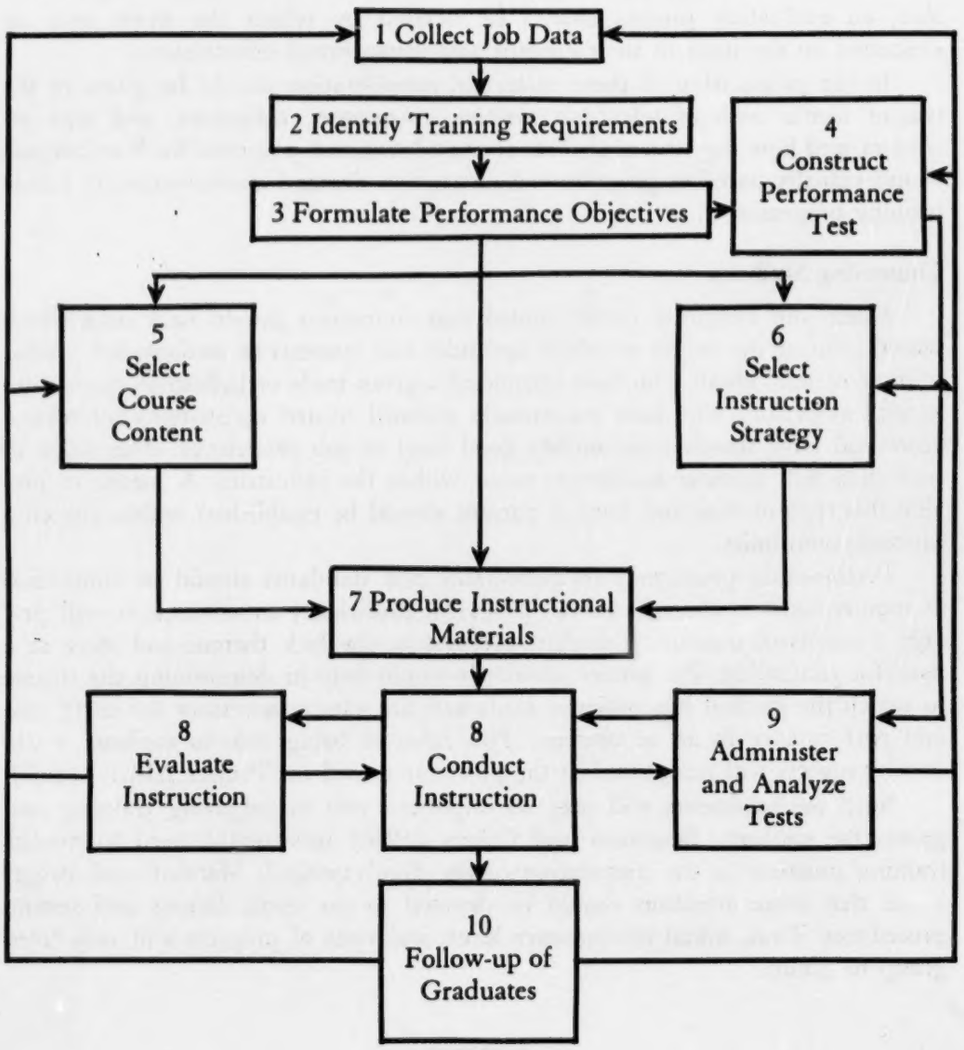
Regardless of where the curriculum is developed, one of these analyses will not be the sole basis for its development. The analyses described above will be incorporated into a systems approach. Once the job is analyzed, performance objectives similar to those suggested by Mager (1962) and recommended by Tuckman (1969) will be formulated. Then, the educational strategy to meet these objectives will be selected along with selection criteria for the students (Miller, 1969). These selection criteria are very important as the curriculum should be designed for the types of persons as well as for the job or job clusters. In fact, Kurth stated that occupational analysis has two broad elements—competencies the worker has or brings to the job and competencies the occupation requires (Larson and Blake, 1969).

One systems approach to preparing students for an occupation is shown in Figure 3. This system includes provisions for the presentation and evaluation of instruction in addition to steps necessary for actual curriculum development. These additional steps, as should be noted from the arrows, are of great value because they provide a feedback of information which may be used for curriculum improvement. In this system, the developers considered the type of student entering the program as part of step 6, select instruction strategy. The use of such a system in planning and conducting an educational program should lead to efficiency in training and better prepared individuals, while it provides a means of constantly updating the training program. If such an approach is used, it should be designed to meet the requirements of the immediate situation.

Educational Curricula and Curriculum Materials

Curricula must be developed to cope with the changes taking place in the construction industries and the mobility of construction workers. Kurth has indicated that spiral curricula which ensure continuity and sequential learning of subject matter which is related to students' interests and needs are of value (Larson and Blake, 1969). Such curricula may use multi-exit points so the students can leave the program with various skill and knowledge levels and then reenter the program to secure additional job preparation. Under this system, initial preparation will be provided in a cluster of occupations while the training will become more specific as job placement approaches.

FIGURE 3
A SYSTEMS APPROACH TO OCCUPATIONAL TRAINING*



* W.R. Tracey, E.B. Flynn, and C.L.J. Legere, "Systems Approach Gets Results," *Training in Business and Industry*, IV (June 1967), 17-21, 32-38.

Curricula prepared at the higher levels—state or national—should be made part of occupational packets which include the curriculum, transparencies, equipment lists and specifications, expendable supplies, shop budgets, a bibliography, and current material. Such preparation and packaging is especially important for those occupations with smaller numbers of workers and in which few materials are available and few training programs are provided. To ensure the value of these materials and to determine the value of materials already available, an evaluation process should be devised by which the items may be evaluated on the basis of their content and instructional effectiveness.

In the preparation of these materials, consideration should be given to the use of media such as television systems, computers, projectors, and tape recorders, and how they can contribute to the educational program. Such techniques as individually paced or programmed instruction demand consideration in future training programs.

Counseling Students

Doerr and Ferguson (1968) stated that counselors should have data which would indicate the degree to which aptitudes and interests of students are similar to those of individuals who have completed a given trade or industrial curriculum as well as persons who have successfully pursued related occupations for several years and have shown a reasonably good level of job proficiency. The value of such data will increase as changes occur within the industries. A means to provide this type of data and keep it current should be established within the educational community.

Performance proficiency measurements and standards should be considered as requirements in the educational program. Proficiency measurements will provide a means of measuring student progress or the lack thereof and serve as a basis for counseling. Proficiency standards would help in determining the degree to which the student has achieved skills and knowledge necessary for entry into and performance in an occupation. The value of being able to evaluate a student's progress was recognized in the procedures used in "Project ABLE" (n.d.).

Such measurements will play an important role in preparing training programs for students. Benjamin and Others (1966) indicated a need to modify training practices in the preparation of the disadvantaged. Marshall and Briggs wrote that more attention should be devoted to the qualifications and testing procedures. Thus, initial performance levels and rates of progress will vary from group to group.

Summary

As Teeple and Kenadjian have indicated, it is unreasonable to expect a neat balance between training completions and job openings. While educators and industry personnel should work toward such a balance, primary emphasis should be directed toward preparing the individual for work. To do this, a curriculum based on occupational analysis, student interest and needs, and the philosophy and objectives of the local school is required.

For the new and emerging occupations, curricula will be developed and evaluated through an educational planning system. As indicated by Roney (1967), this planning will involve four major steps: occupational analysis; program planning; program development and testing; and documentation and dissemination of results. One will note that this is very similar to the system reportedly used in the past and being used today. System changes necessary for the future involve placing additional emphasis on each of the four steps and employing stricter controls and guidelines. Special consideration will be given to occupational analysis and dissemination of the results.

But are new curricula alone enough? To provide and train the necessary workers, improved counseling and recruiting programs and techniques will be required along with improved uses of curriculum materials and teaching techniques. Efforts must be made to attract members of minority groups and women to meet future worker requirements. Research should be conducted to relate technological change and the responsiveness of vocational education curricula to this change.

No educational system can supply the relevant level of skills and competence required without receiving the active feedback and support of industry (Kraft, 1969). Because of this, the systems approach will not be used only in developing curricula but also for providing instruction. Future curriculum development and instruction will require that a complete and flexible communications network be established among all those affected by the educational program.

DESCRIPTION OF THE BIBLIOGRAPHY

Compilation

References believed to be of value to persons desiring information relating to the planning of curricula for new occupations in the construction industries were identified through a search of both Educational Resources Information Center (ERIC) publications and non-ERIC publications. ERIC publications included:

Abstracts of Instructional Materials in Vocational and Technical Education (AIM), Fall 1967—Spring 1970.

Abstracts of Research and Related Materials in Vocational and Technical Education (ARM), Fall 1967—Spring 1970.

Current Index to Journals in Education, Volume I; Volume II, Numbers 1-3.

Manpower Research: Inventory for Fiscal Years 1966 and 1967.

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The three non-ERIC sources of information which were searched were:

CIRF Abstracts. Geneva, Switzerland: The International Vocational Training Information and Research Centre, C/O The International Labor Organization, Volume I-VIII; Volume IX, First Dispatch (February 1970).

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Ehrenreich, Julia W., ed. *Education Index.* New York: The H. W. Wilson Company, July 1964—May 1970.

These publications were searched manually by senior-level staff of The Center for Vocational and Technical Education, The Ohio State University, and/or by the writer. During the search, a broad set of descriptors was developed and used in an effort to obtain information related to every facet of the construction industries and related curricula.

An additional search was made of the *Research in Education* indexes by computer in an attempt to identify material related to curricula development in the construction industries. ERIC descriptors and strategies adapted from the *Thesaurus of Eric Descriptors* and used in the search are outlined below:

CURRICULUM DEVELOPMENT	and	VOCATIONAL EDUCATION
or CURRICULUM DESIGN		or TECHNICAL EDUCATION
or CURRICULUM PLANNING		or INDUSTRIAL EDUCATION
		or JOB TRAINING
		or COOPERATIVE EDUCATION

In addition to these searches of specific sources, a cursory search was made of related materials available in the library of The Center for Vocational and Technical Education.

Organization

The limited bibliography prepared as a result of these searches and an elimination process was organized into two sections, literature identified from ERIC publications and that identified from non-ERIC publications. Materials identified through the cursory search of library materials were placed into one of these sections by the writer on the basis of whether they were listed in the ERIC publications reviewed earlier. If the materials identified were not listed in these publications, they were classified as from non-ERIC publications.

These sections were then divided into five sub-sections for ease of use. Items listed in each of these sub-sections were arranged alphabetically by author or title. The five sub-sections selected were:

Need for Educational Programs

Materials cited in this section contain information related to the need for trained manpower in the construction industries and the types of programs through which training is provided.

Curricula and Curriculum Materials

This section includes citations which concern education in the construction industries. These citations include material concerning program descriptions, course content, and instructional materials suitable for apprentice, secondary, and post-secondary programs.

Curriculum Development

Documents listed in this section are those which deal with or are related to some aspect of curriculum development in the construction industries such as related research reports and projects and needed revisions.

Methodology of Curriculum Development

This section of the bibliography contains documents concerning the procedures or methods which have applicability to curriculum development for new and emerging occupations.

Information Sources

Publications cited in this section of the biblography are those which were searched in an attempt to obtain relevant material or which contain information of a general nature related to construction industries.

While the bibliographic entries were placed into these categories by the writer, such categorization is not meant to be exclusive. The various publications were listed in only one category, not in several categories. Because of this, references in categorical areas related to the area of one's primary interest should be consulted for possible additional information.

Entries were selected on the basis of a review for their applicability to curricula in the construction industries. It is believed that the entries included in the bibliography are representative of the materials available in relation to this topic and will provide a basic orientation to the occupations in the construction industries.

Availability of Documents

Publications and documents identified as pertinent to this review and analysis and listed in the bibliography may be secured through many sources. However, for easier access to these items, certain sources should be considered.

ERIC publications from which literature was identified may be determined by the prefix to the identifying document number. Prefixes found in this bibliography are:

Prefix	Publication
ED	RIE
EJ	CIJE
MP	Manpower Inventory
VT	AIM, ARM

Most ED and MP documents are available on microfiche (MF) or hard copy (HC) from the ERIC Document Reproduction Service (EDRS). Orders must be forwarded to:

ERIC Document Reproduction Service
National Cash Register Company
4936 Fairmont Avenue
Bethesda, Maryland 20014

EDRS prices cited in this bibliography reflect pricing in effect at the time of publication. Recent price schedules and ordering information available in the current issue of *AIM*, *ARM*, or *Research in Education* should be consulted prior to placing an order.

CIJE entries can usually be found in periodicals which are available in local libraries. Items with a VT prefix can be found on microfiche in a VT-ERIC set which is available in many libraries or which may be ordered from EDRS. ED, MP, and VT items not available on microfiche or hard copy from EDRS may be secured from other sources which are listed in the bibliography.

Publications and documents not listed as ERIC publications should be secured through local libraries or from the publisher.

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